Estd. 1962
NAAC 'A' Grade

SHIVAJI UNIVERISTY, KOLHAPUR-416 004. MAHARASHTRA
PHONE : EPABX-2609000 website- www.unishivaji.ac.in
FAX 0091-0231-2691533 & 0091-0231-2692333 – BOS - 2609094
शिवाजी विद्यापीठ, कोल्हापूर – 416004.
दुरध्वनी (ईपीएबीएक्स) २६०९००० (अभ्यास मंडळे विभाग– २६०९०९४)
फॅक्स : ००९१-०२३१-२६९१५३३ व २६९२३३३.e-mail:bos@unishivaji.ac.in

SU/BOS/Science & Technology /864 **Date: 20/12/2023**

To,

The Principal, **All affiliated colleges,** **Shivaji University, Kolhapur.**	**The Head,** **Department of Mathematics,** **Shivaji University, Kolhapur**

Subject:Regarding minor changes in the syllabi of M.Sc.Part-I (Mathematics) Sem-I & II under the Faculty of Science & Technology.

Sir/Madam,

With reference to the subject mentioned here above, I am directed to inform you that the university authorities have accepted and granted approval to the minor changes in the syllabi of **Research Methodology-I and Lattice Theory-II.** of M.Sc.Part-I (Mathematics) Sem- I & II under the Faculty of Science & Technology.

This minor change in said Syllabus of will be implemented from the academic year 2024-25.

You are therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,

Yours faithfully,

Dy. Registrar

Copy to :-

1	The Dean, Faculty of Science & Technology	8	Appointment Section
2	The Chairman, Respective, BOS	9	Centre for Distance Education
3	Exam Section	10	Computer Centre
4	Eligibility Section	11	Affiliation Section (U.G.)
5	O.E. I Section	12	Affiliation Section (P.G.)
6	O.E. II Section	13	P.G.Admission Section
7	O.E. III Section	14	P.G.Seminar Section

SHIVAJI UNIVERSITY, KOLHAPUR - 416004,
MAHARASHTRA
PHONE:EPABX–2609000, www.unishivaji.ac.in, bos@unishivaji.ac.in
शिवाजी विद्यापीठ, कोल्हापूर - ४१६००४, महाराष्ट्र
दूरध्वनी - ईपीएबीएक्स - २६०९०००, अभ्यासमंडळे विभाग दुरध्वनी विभाग ०२३१–२६०९०९४

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"A++" Accredited by
NAAC(2021)
With CGPA 3.52

जा.क्र.शिवाजी वि./अमं/732 दिनांक. 09/10/ 2023

प्रति,

मा. अध्यक्ष व सदस्य,
सर्व अभ्यास/अस्थायी मंडळे (सायन्स)
शिवाजी विद्यापीठ, कोल्हापूर

विषय :– शैक्षणिक वर्षे 2023–24 पासून एम.एस्सी. अभ्यासक्रमाच्या आराखडया (Structure) बाबत.

महोदय/महोदया,

उपरोक्त विषयास अनुसरून आदेशान्वये कळविण्यात येते की, राष्ट्रीय शैक्षणिक धोरण, 2020 ची राज्यातील अंमलबजावणीच्या अनुषंगाने विद्यापीठ अधिकार मंडळाच्या निर्णयानुसार शैक्षणिक वर्षे 2023–24 पासुन एम.एस्सी. अभ्यासक्रमासाठी सोबत जोडलेला कॉमन आराखडा **(Structure)** व **Formatting (Templet)** लागू करण्यात आले आहे याची नोंद घ्यावी.

सदरची बाब सर्व शिक्षक, विद्यार्थी व संबंधीतांच्या निदर्शनास आणावी.

कळावे,

आपला विश्वासू

(डॉ. एस. एम. कुबल)
उपकुलसचिव

प्रतः–

प्र.अधिष्ठाता विज्ञान व तंत्रज्ञान विद्याशाखा
मा.संचालक परीक्षा व मुल्यमापन मंडळ
परीक्षक नियुक्ती विभाग–1,2
सर्व परीक्षा विभाग (ऑन)
माहितीसाठी व पुढील योग्य त्या कार्यवाहीसाठी.

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SHIVAJI UNIVERSITY, KOLHAPUR - 416 004, MAHARASHTRA
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दूरध्वनी - ईपीएबीएक्स - २६०९०००, अभ्यासमंडळे विभाग दुरध्वनी ०२३१—२६०९०९३/९४

SU/BOS/Science/482 **Date: 01/07/2023**

To,

The Principal, All Concerned Affiliated Colleges/Institutions Shivaji University, Kolhapur	The Head/Co-ordinator/Director All Concerned Department (Science) Shivaji University, Kolhapur.

Subject: Regarding syllabi of M.Sc. Part-I (Sem. I & II) as per NEP-2020 degree programme under the Faculty of Science and Technology.

Sir/Madam,

With reference to the subject mentioned above, I am directed to inform you that the university authorities have accepted and granted approval to the revised syllabi, nature of question paper and equivalence of M.Sc. Part-I (Sem. I & II) as per NEP-2020 degree programme under the Faculty of Science and Technology.

M.Sc. Part I (Sem I & II) as per NEP-2020			
1.	Mathematics	5.	Botany
2.	Mathematics (Distance Mode)	6.	Statistics
3.	Mathematics (Online Mode)	7.	Applied Statistics and Informatics
4.	Zoology		

This syllabus, nature of question and equivalence shall be implemented from the academic year 2023-2024 onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website **www.unishivaji.ac.in**)

The question papers on the pre-revised syllabi of above-mentioned course will be set for the examinations to be held in October /November 2023 & March/April 2024. These chances are available for repeater students, if any.

You are, therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,

Dy Registrar
Dr. S. M. Kubal

Copy to:

1	The Dean, Faculty of Science & Technology	8	P.G. Admission/Seminar Section
2	Director, Board of Examinations and Evaluation	9	Computer Centre/ Eligibility Section
3	The Chairman, Respective Board of Studies	10	Affiliation Section (U.G.) (P.G.)
4	B.Sc. Exam/ Appointment Section	11	Centre for Distance Education

SHIVAJI UNIVERSITY, KOLHAPUR

Established: 1962

A^{++} Accredited by NAAC (2021) with CGPA 3.52

Structure and Syllabus in Accordance with

National Education Policy - 2020

with Multiple Entry and Multiple Exit

Master of Science (Mathematics)
Distance Mode

under
Faculty of Science and Technology

(To Be Implemented From Academic Year 2023-24)

INDEX

1. Preamble

Shivaji University Kolhapur offers dual mode system education i.e. regular as well as external education. The external education is beneficial to all those students who are not able to take conventional education. The external section is converted into Centre for Distance Education which was established in the year 2005. M.Sc. Mathematics program was established in the year 2006 in the distance mode. Centre for Distance education offering self learning material, contact sessions etc. M.Sc. Mathematics through distance education will be helpful for getting the job, promotion in the present job or for appearing for the competitive examinations. In 2022 Centre for distance education converted into Centre for distance & online education by establishing online program.

2. Duration:

The M.Sc. (Mathematics)(Distance) programme will be of TWO years (4 semesters).

3. Eligibility for Admission:

Eligibility for level 6:

i) Any candidate who has successfully completed B. Sc. with a principal subject Mathematics or with a subsidiary subject Mathematics of this University or of any other statutory University recognized by UGC, New Delhi.

OR

ii) Any candidate who has successfully completed the Bachelor's degree with Mathematics courses at Second Year of Bachelor's degree of this University or of any other statutory University recognized by UGC, New Delhi.

OR

iii) Any candidate who has successfully completed level 5.5 with major or minor subject as Mathematics of this University or of any other statutory University recognized by UGC, New Delhi.

Eligibility for level 6.5:

i) Any candidate who has successfully completed Post Graduate Diploma (Level 6.0) in Mathematics of this University or of any other statutory University recognized by UGC, New Delhi.

OR

ii) Any candidate who has successfully completed Bachelor's Degree (Honours / Honours with Research) (Level 6.0) with principal / major subject Mathematics of this University or of any other statutory University recognized by UGC, New Delhi.

OR

iii) Completed all requirements of the relevant Post Graduate Diploma (Level 6.0) in Mathematics.

4. Medium of Instruction:

The medium of Instruction will be English.

5. Programme Structure

Structure in Accordance with National Education Policy - 2020
With Multiple Entry and Multiple Exit Options
M.Sc. (Mathematics) (Distance Mode) Part – I (Level-6.0)

	Course Code	Credit	Examination Scheme					
			University Assessment (UA)			Internal Assessment (IA)		
			Maximum Marks	Minimum Marks	Exam. Hours	Maximum Marks	Minimum Marks	Exam. Hours
Semester-I								
Major Mandatory	MMT-101	4	80	32	3	20	8	1
	MMT -102	4	80	32	3	20	8	1
	MMT-103	4	80	32	3	20	8	1
	MMT -104	2	40	16	2	10	4	1/2
Major Elective	MET-105	4	80	32	3	20	8	1
Research Methodology	RM-106	4	80	32	3	20	8	1
Total		22	440			110		
Semester-II								
Major Mandatory	MMT-201	4	80	32	3	20	8	1
	MMT -202	4	80	32	3	20	8	1
	MMT -203	4	80	32	3	20	8	1
	MMT -204	2	40	16	2	10	4	1/2
Major Elective	MET-205	4	80	32	3	20	8	1
OJT/FP	OJT-206	4	80	32	3	20	8	1
Total		22	440			110		
Total (Sem I + Sem II)		44						

• MMT – Major Mandatory Theory • MMPR – Major Mandatory Practical • MET – Major Elective Theory • MEPR – Major Elective Practical • RM - Research Methodology • OJT/FP- On Job Training/ Field Project	• Total Marks for M.Sc.-I : **1100** • Total Credits for M.Sc.-I (Semester I & II) : 44 • ***Separate passing is mandatory for University and Internal Examinations***

*Evaluation scheme for OJT/FP shall be decided by concerned BOS

- **Requirement for Entry at Level 6.0:**

1. Any candidate who has successfully completed B. Sc. with a principal subject Mathematics or with a subsidiary subject Mathematics of this University or of any other statutory University recognized by UGC, New Delhi.

OR

2. Any candidate who has successfully completed the Bachelor's degree with Mathematics courses at Second Year of Bachelor's degree of this University or of any other statutory University recognized by UGC, New Delhi.

OR

3. Any candidate who has successfully completed level 5.5 with major or minor subject as Mathematics of this University or of any other statutory University recognized by UGC, New Delhi.

- **Requirement for Exit after Level 6.0:**
  Students can exit after completion of Level 6.0 with Post Graduate Diploma in Mathematics

Structure in Accordance with National Education Policy - 2020
With Multiple Entry and Multiple Exit Options
M.Sc. (Mathematics)(Distance Mode) Part – II (Level-6.5)

	Course Code	Credit	Examination Scheme					
			University Assessment (UA)			Internal Assessment (IA)		
			Maximum Marks	Minimum Marks	Exam. Hours	Maximum Marks	Minimum Marks	Exam. Hours
Semester-III								
Major Mandatory	MMT-301	4	80	32	3	20	8	1
	MMT -302	4	80	32	3	20	8	1
	MMT -303	4	80	32	3	20	8	1
	MMT-304	2	40	16	2	10	4	1/2
Major Elective	MET-305	4	80	32	3	20	8	1
Research Project	RP-307	4	80	32	3	20	8	1
Total		22	440			110		
Semester-IV								
Major Mandatory	MMT-401	4	80	32	3	20	8	1
	MMT -402	4	80	32	3	20	8	1
	MMT -403	4	80	32	3	20	8	1
Major Elective	MET -405	4	80	32	3	20	8	1
Research Project	RP -407	6	100	40	3	50	20	2
Total		22	420			130		
Total (Sem III + Sem IV)		44						

• MMT – Major Mandatory Theory • MMPR – Major Mandatory Practical • MET – Major Elective Theory • MEPR – Major Elective Practical • RP- Research Project	• Total Marks for M.Sc.-II : **1100** • Total Credits for M.Sc.-II (Semester III & IV) : 44 • ***Separate passing is mandatory for University and Internal Examinations***
Evaluation scheme for Research Project: 80% weightage for University assessment and 20% for Internal Assessment.	

- **Requirement for Entry at Level 6.5:**

1. Any candidate who has successfully completed Post Graduate Diploma (Level 6.0) in Mathematics of this University or of any other statutory University recognized by UGC, New Delhi.

OR

2. Any candidate who has successfully completed Bachelor's Degree (Honours / Honours with Research) (Level 6.0) with principal / major subject Mathematics of this University or of any other statutory University recognized by UGC, New Delhi.

OR

3. Completed all requirements of the relevant Post Graduate Diploma (Level 6.0) in Mathematics.

- **Requirement for Exit after Level 6.5:**
  Students can exit after completion of Level 6.5 with Post Graduate in Mathematics.

6. Programme Outcomes (POs)

- To develop problem-solving skills and apply them independently to problems in pure and applied mathematics.
- To develop abstract mathematical thinking.
- To improve the abilities of students this will be helpful to qualify competitive examinations.
- Apply knowledge of Mathematics, in all the fields of learning including higher research.
- Work effectively as an individual, and also as a member or leader in multi-linguistic and multi-disciplinary teams.
- To qualify lectureship and fellowship exams such as NET, GATE, SET etc.
- Understand the basic concepts, fundamental principles and mathematical theories related to various courses and their relevance to other sciences.

7. Course Codes

M. Sc.(Mathematics) (Distance Mode) Part I (Semester I and II)

Semester	Code	Course Code	Title of New Course
I	MMT-101	MSU0325MML826G1	Linear Algebra
I	MMT-102	MSU0325MML826G2	Real Analysis
I	MMT-103	MSU0325MML826G3	Ordinary Differential Equations
I	MMT-104	MSU0325MML826G4	Numerical Analysis-I
I	MET-105	MSU0325MEL826G1	Combinatorics
		MSU0325MEL826G7	Linear programming and its applications
I	RM-106	MSU0325RML826G	Research Methodology
II	MMT-201	MSU0325MML826H1	Algebra
II	MMT-202	MSU0325MML826H2	Topology
II	MMT-203	MSU0325MML826H3	Advanced Calculus
II	MMT-204	MSU0325MML826H4	Numerical Analysis - II
II	MET-205	MSU0325MEL826H1	Number Theory
		MSU0325MEL826H7	Quantitative techniques in operations Research
II	OJT-206 / FP-206	MSU0325OJP826H / MSU0325FPP826H	On job Training / Field project

M. Sc.(Mathematics) (Distance Mode) Part II (Semester III and IV)

Semester	Code	Course Code	Title of New Course
III	MMT-301	MSU0325MML926I1	Functional Analysis
III	MMT-302	MSU0325MML926I2	Complex Analysis
III	MMT-303	MSU0325MML926I3	Classical Mechanics
III	MMT-304	MSU0325MML926I4	Advanced Discrete Mathematics
III	MET-305	MSU0325MEL926I2	Fluid Dynamics
		MSU0325MEL926I9	Fuzzy Set Theory
III	RP-306	MSU0325RPP926I	Research Project
IV	MMT-401	MSU0325MML926J1	Integral Equations
IV	MMT-402	MSU0325MML926J2	Field Theory
IV	MMT-403	MSU0325MML926J3	Partial Differential Equations
IV	MET-404	MSU0325MEL926J2	Computational Fluid Dynamics
		MSU0325MEL926J9	Fuzzy Relation and Logic
IV	RP-405	MSU0325RPP926J	Research Project

M.Sc. (Mathematics)(Distance Mode) Part–I (Level-6.0)

Semester	**Mandatory Major** 4 credits	**Mandatory Major** 2 credits	**Mandatory Elective (any one)** 4 credits	**Mandatory RM and OJT/FP** 4 credits
I	1) Linear Algebra 2) Real Analysis 3) Ordinary Differential Equations	Numerical Analysis-I	1) Combinatorics 2) Linear programming and its applications	Research Methodology
II	1) Algebra 2) Topology 3) Advanced Calculus	Numerical Analysis - II	1) Number Theory 2) Quantitative techniques in operations Research	On job Training/ Field project

M.Sc. (Mathematics)(Distance Mode) Part–II (Level-6.5)

Semester	**Mandatory Major** 4 credits	**Mandatory Major** 2 credits	**Mandatory Elective (any one)** 4 credits	**Mandatory RM and OJT/FP**
III	1) Functional Analysis 2) Complex Analysis 3) Classical Mechanics	Advanced Discrete Mathematics	1) Fluid Dynamics 2) Fuzzy Set Theory	Research Project (4 credits)
IV	1) Integral Equations 2) Field Theory 3) Partial Differential Equations	---	1) Computational Fluid Dynamics 2) Fuzzy Relation and Logic	Research Project (6 credits)

M. Sc. Mathematics (Distance Mode) (Part I) (Level-6.0) (Semester I)
(NEP-2020)
(Introduced from Academic Year 2023-24)

Title of Course: Linear Algebra

Total Credits: 04

Course Outcomes: Upon successful completion of this course, the student will be able to:

1. understand basic notions in Linear Algebra and use the results in developing advanced mathematics.
2. study the properties of Vector Spaces, Linear Transformations, Algebra of Linear Transformations and Inner product space in some details.
3. construct Canonical forms and Bilinear forms.
4. apply knowledge of Vector space, Linear Transformations, Canonical Forms and Bilinear Transformations.

Unit I: Elementary Basic concepts, Linear Independence and Bases, Dual Spaces, Annihilator of a subspace, Quotient Spaces. Inner product spaces, Linear Transformations. **15 Lectures**

Unit II: The Algebra of Linear transformations, Characteristic Roots, Matrices of linear transformations, Eigen values and eigenvectors of a linear transformation, Canonical Forms: Similarity of linear transformations. **15 Lectures**

Unit III: Triangular form, Nilpotent transformations, Jordan Form, Trace and transpose, Determinants. **15 Lectures**

Unit IV: Hermitian, Unitary and Normal linear transformations, Bilinear Forms, Symmetric Bilinear Forms, Skew Symmetric Bilinear Forms. **15 Lectures**

Seminars, Tutorials, Problem solving session and group discussions on above four units

Recommended Book(s):

1. Herstein I. N. : Topics in Algebra, 2nd Edition, Willey Eastern Limited.
2. Hoffman, Kenneth and Kunze R: Linear Algebra, Prentice Hill of India Private Limited., 1984.

Reference Books:

1. A. R. Rao and P. Bhimashankaran, Linear Algebra, Hidustan Book Agency.
2. Surjit Singh, Linear Algebra, Vikas publishing House (1997).
3. Gilbert Strang: Introduction to Linear Algebra, Wellesley-Cambridge Press

M. Sc. Mathematics (Distance Mode) (Part I) (Level-6.0) (Semester I)
(NEP-2020)
(Introduced from Academic Year 2023-24)

Title of Course: Real Analysis
Total Credits: 04

Course Outcomes: Upon successful completion of this course, the student will be able to:
1. generalize the concept of length of interval.
2. analyze the properties of Lebesgue measurable sets.
3. demonstrate the measurable functions and their properties.
4. understand the concept of Lebesgue integration of measurable functions.
5. characterize Riemann and Lebesgue integrability.
6. prove completeness of L^P Spaces.

UNIT I:
σ-algebra and Borel Sets of Real numbers, Lebesgue Outer Measure, The sigma algebra of Lebesgue measurable sets, Outer and Inner approximation of Lebesgue Measurable Sets, Countable Additivity, Continuity and Borel-Cantelli Lemma. **15 Lectures**

UNIT II:
Nonmeasurable Sets, Lebesgue Measurable Functions: Sums, Product and Composition of Measurable Functions, Sequential Pointwise Limits and Simple Approximation, Littlewood's Three Principles (Statement and importance of Egoroff's Theorem and Lusin's Theorem) **15 Lectures**

UNIT III:
Lebesgue Integral of a Bounded Measurable Function over a Set of Finite Measure, Lebesgue integral of a Measurable Non-negative Function, The General Lebesgue Integral, Characterizations of Riemann and Lebesgue Integrability. **15 Lectures**

UNIT IV:
Lebesgue's Theorem (Statement Only), Functions of Bounded Variations, Jordan's theorem, Absolutely Continuous Functions, Integrating Derivatives: Differentiating Indefinite Integrals, The L^P Spaces: Normed Linear Spaces, The Inequalities of Young, Hölder and Minkowski, The Riesz-Fischer Theorem.
15 Lectures

Seminars, Tutorials, Problem solving session and group discussions on above four units

Recommended Books:

1. H. L. Royden, P.M. Fitzpatrick, Real Analysis, Fourth Edition, PHI Learning Pvt. Ltd., New Delhi, 2010

Reference Books:

1. G. de Barra, Measure Theory and Integration, New Age International (P) Ltd., 1981.
2. I. K. Rana, An Introduction to Measure and Integration, Narosa Book Company, 1997.
3. S. K. Berberian, Measure and Integration, McMillan, New York, 1965.
4. P. K. Jain, V. P. Gupta, Lebesgue measure and Integration, Wiley Easter Limited, 1986.
5. W. Rudin, Principles of Mathematical Analysis, McGraw-Hill Book Co, 1964.
6. P. K. Halmos, Measure Theory, Van Nostrand, 1950.

M. Sc. Mathematics (Distance Mode) (Part I) (Level-6.0) (Semester I)
(NEP-2020)
(Introduced from Academic Year 2023-24)

Title of Course: Ordinary Differential Equations

Total Credits: 04

Course Outcomes: Upon successful completion of this course, the student will be able to:

1. study basic notions in Differential Equations and use the results in developing advanced mathematics.
2. solve problems modeled by linear differential equations.
3. use power series methods to solve differential equations about ordinary points and regular singular points.
4. construct approximate solutions using method of successive approximation.
5. establish uniqueness of solutions.

Unit I : Linear differential equations with constant coefficients: The second order homogeneous equation, initial value problems for second order equations, linear dependence and independence, formula for the Wronskian, the non-homogeneous equations of order two.
15 Lectures

Unit II: The homogeneous equations of order n, initial value problems for the nth order equations, the non-homogeneous equation of nth order. Linear equations with variable coefficients: Initial value problems for the homogeneous equations. Solutions of the homogeneous equations, the Wronskian and linear independence. **15 Lectures**

Unit III: Reduction of the order of a homogeneous equation, the non-homogenous equations, homogeneous equations with analytic coefficients, the Legendre equations. Linear equations with regular singular points: The Euler equations, second order equations with regular singular points.
15 Lectures

Unit IV: The Bessel equation, regular singular points at infinity. Existence and uniqueness of solutions: The method of successive approximations, the Lipschitz condition, convergence of the successive approximation. **15 Lectures**

Seminars, Tutorials, Problem solving session and group discussions on above four units

Recommended books:

1. E. A. Coddington: An introduction to ordinary differential equations. (2012) Prentice Hall of India Pvt.Ltd. New Delhi.

Reference books:

1. G. Birkoff and G.G.Rota, Ordinary differential equations, John Willey and Sons.
2. G.F. Simmons, Differential Equations with Applications and Historical note, McGraw-Hill, Inc. New York. (1972).
3. E.A. Coddington and Levinson, Theory of ordinary differential equations, McGraw-Hill, New York(1955).
4. E.D. Rainvills, Elementary differential equations, The Macmillan company, New York, (1964).

M. Sc. Mathematics (Distance Mode) (Part I) (Level-6.0) (Semester I)
(NEP-2020)
(Introduced from Academic Year 2023-24)

Title of Course: Numerical Analysis - I

Total Credits: 02

Course Outcomes: Upon successful completion of this course, the student will be able to:

1) apply the methods to solve linear and nonlinear equations.

2) find numerical integration and analyze error in computation.

3) solve differential equations using various numerical methods.

4) determine eigen values and eigen vectors of a square matrix.

5) construct LU decomposition of a square matrix.

Unit I: Transcendental & polynomial equations: Bisection method, Iteration methods based on First degree equation (Secant method, Regula-Falsi method and Newton-Raphson method). Rate of Convergence, Iterative methods (Birge-Vieta method and Bairstow method).

15 Lectures

Unit II: System of linear algebraic equations and eigen value problems: Matrix factorization methods (Doolittle's method, Crout's method), Iteration methods (Jacobi iteration method, Gauss-Seidel iteration method), convergence analysis of iterative methods, Eigen values and eigenvectors, Gerschgorin theorem, Brauer theorem, Jacobi method for symmetric matrices, Power method.

15 Lectures

Seminars, Tutorials, Problem solving session and group discussions on above four units

Recommended Books:

1. M. K. Jain, S. R. K. Iyengar, R. K. Jain, Numerical methods for scientific and Engineering Computation (Fifth Edition), New Age International Publishers 2007.

Reference Books:

1. S. S. Sastry, Introductory methods of Numerical Analysis (Fifth Edition), PHI learning Private Limited, New Delhi 2012.
2. D. Kincaid, W. Cheney, Numerical Analysis Mathematics of Scientific Computing (Third Edition), American Mathematical Society.
3. J.C. Butcher, Numerical methods for ordinary differential equations (Second Edition), John Wiley & Sons Ltd, 2008.
4. Kendall E. Atkinson, An Introduction to Numerical Analysis (Second Edition), John Wiley & Sons 1988.

M. Sc. Mathematics (Distance Mode) (Part I) (Level-6.0) (Semester I)
(NEP-2020)
(Introduced from Academic Year 2023-24)

Title of Course: Combinatorics

Total Credits: 04

Course Outcomes: Upon successful completion of this course, the student will be able to:

1. describe Pigeonhole principle and use it to solve problems.
2. use definitions and theorems from memory to construct solutions to problems
3. use Burnside Frobenius Theorem in counting's.
4. use various counting techniques to solve various problems.
5. apply combinatorial ideas to practical problems.
6. improve mathematical verbal communication skills.

Unit I: The sum rule and product rule, permutations and combinations, the Pigeonhole principle, Ramsay numbers, Catalan numbers, sterling numbers. **15 Lectures**

Unit II: Further basic tools, generalized permutations and combinations sequences and selections, the inclusion and exclusion principle, systems of distinct representatives, solved problems derangements and other constrain derangements. **15 Lectures**

Unit III: Combinatorial number theory, the permanent of a matrix, Rook polynomials and Hit polynomials, SDR and coverings, (Sperners theorem and Symmetric chain decomposition, posets and Dilworth's theorem) statements. **15 Lectures**

Unit IV: Generating functions and recurrence relations, ordinary and exponential generating functions, partitions of a positive integer, recurrence relations, algebraic solutions of linear recurrence relations with constant coefficients and solutions of recurrence relations using generating functions. **15 Lectures**

Seminars, Tutorials, Problem solving session and group discussions on above four units

Recommended Books:

1. V. K. Balkrishnan: Combiactorics, Shaums Outlines Series, Mc Grow Hill Inc.

Reference Books:

1. Richard Brualdi – Introductory Combinatosics North Holland.
2. V. Krishnamurthy: Combinatorics, E. W. Press
3. A. Tucker: Combinatorics, John Wiley & Sons, Inc
4. C. Vasudev, Theory and Problems of Combinatorics, New Age International.

(NEP-2020)
(Introduced from Academic Year 2023-24)

Title of Course: Linear programming and its applications
Total Credits: 04

Course outcomes: Upon successful completion of this course, the student will be able to --
1. Recognize convex sets and convex functions.
2. Calculate maximum and minimum value of a function of several variables.
3. Solve LPP by simplex and dual simplex methods.

Unit – I: General formulation of linear programming problem, Slack and surplus variables, standard form of LPP, Solution of LPP, Feasible solution of LPP, Basic solution , Basic feasible solution, Optimum Basic feasible solution, unbounded solution, Lines and hyperplanes, Convex sets, polyhedron convex set, extreme points of a convex set, convex combination of vectors, convex hull , convex polyhedron, convex function, maxima and minima of functions of several variables. **15 lectures**

Unit -II : Introduction to linear programming problems ,fundamental theorem of linear programming, computational procedure of a simplex method, examples . Two phase method, Examples, big M method , disadvantages of big M method over two phase method , problem of degeneracy, Resolution of degeneracy, unbounded solutions, non-existing feasible solutions **15 lectures**

Unit -III : Duality in linear programming, rules for converting any primal into its dual, Duality theorems, fundamental duality theorem, The dual simplex method , Computational procedure of dual simplex method, examples. **15 lectures**

Unit – IV: Integer linear programming: Importance of integer Programming problems, Gomory's all IPP Method, Gomorian slack variable, Construction of Gomory's Constraints, Gomory's cutting plane Algorithm, Computational procedure for the solution of IPP by Gomorys Method, The Branch and Bound method, branch and bound algorithm, concept goal programming, single goal models,multiple goal models, multiple goals with equal priorities, multiple goal with priorities, multiple goals with priorities and weights, formulation of goal programming models, methodology of solution procedure, graphical solution. simplex method applied to GP problems.

15 lectures

Seminars, Tutorials, Problem solving session and group discussions on above four units

Recommended Book: 1 S.D. Sharma: Operations Research, Kedar Nath Ram Noth and co. 15th edition reprint 2009

Reference Books: 1.J.K.Sharma : Operations research
2. Kanti Swarup ,P.K.Gupta and Manmohan : Operations research, S.Chand& Co.
3. Hamady Taha : Operations Research :Mac Millan Co.
4. R.K.Gupta : Operations Research Krishna Prakashan Mandir, Meeru
5. G.Hadley : Linear programming, Oxford and IBH Publishing Co.
6. S.I.Gass : Linear Programming, Mc Graw Hill Book Co

M. Sc. Mathematics (Distance Mode) (Part I) (Level-6.0) (Semester I)
(NEP-2020)
(Introduced from Academic Year 2023-24)

Title of Course: Research Methodology

Total Credits: 04

Course Outcomes: Upon successful completion of this course, the student will be able to:

1. understand skill of mathematical writing
2. Understand wetting research paper
3. revise the drafts, check the proofs
4. understand the copy copyright issues
5. Type in mathematics using latex

Unit I: Mathematical Writing: What Is a Theorem?, Proofs, The Role of Examples, Definitions, Notation, Words versus Symbols, Displaying Equations, Parallelism, Dos and Don'ts of Mathematical Writing. Writing a Paper: Audience, Organization and Structure, Title, Author List, Date, Abstract, Key Words and Subject Classifications. **15 Lectures**

Unit II: Writing a Paper (Continued...): The Introduction, Review of Literature, Computational Experiments, Tables, Citations, Conclusions, Acknowledgements, Appendix, Reference List, Specifics and Deprecated Practices. Revising a Draft: How to Revise, Examples of Prose, Examples Involving Equations, Examples from My Writing, A Revised Proof, A Draft Article for Improvement. **15 Lectures**

Unit III: Publishing a Paper: Choosing a Journal, Submitting a Manuscript, The Refereeing Process, How to Referee, The Role of the Copy Editor, Checking the Proofs, Copyright Issues, SIAM Journal Article: A case study. Writing and Defending a Thesis: The Purpose of a Thesis, Content, Presentation, The Thesis Defence. **15 Lectures**

Unit IV: Quality indices of research publication: impact factor, H- index, science citation index., Using web for literature review: Google Scholar, Scopus, MathSciNet. Latex –Basic Typesetting of Mathematics, Typesetting Theorems. **15 Lectures**

Seminars, Tutorials, Problem solving session and group discussions on above four units

Recommended Book:

1. Higham Nicholas J., Handbook of writing for the mathematical sciences, SIAM, 1961.
1. LATEX Tutorials A Primer, Indian TEX Users Group, Trivandrum, India, 2003 September.https://www.tug.org/twg/mactex/tutorials/ltxprimer-1.0.pdf

References:

1. Stegmann J., How to evaluate journal impact factors, Nature, 390(6660), (1997), 550-550.
2. Kaltenborn K. F. and Kuhn K, The journal impact factor as a parameter for the evaluation of researchers andresearch, Revista Espanola de Enfermedades Digestivas, 96(7), (2004), 460-476.
3. Hirsch J. E., An index to quantify an individual's scientific research output, https://arxiv.org/abs/physics/0508025
4. Garfield E., The evolution of the Science Citation Index, International Microbiology, 10, (2007), 65-69. DOI: 10.2436/20.1501.01.10
5. A Primer of Mathematical Writing, Steven G. Krantz, Universities Press Hyderabad 1998.https://arxiv.org/pdf/1612.04888.pdf 6McGraw- Hill's Concise Guide to Writing Research Papers, Carol Ellison, McGraw-Hill, New York, 2010.

M. Sc. Mathematics (Distance Mode) (Part I) (Level-6.0) (Semester I)
(NEP-2020)
(Introduced from Academic Year 2024-25)

Title of Course: Research Methodology

Total Credits: 04

Course Outcomes: Upon successful completion of this course, the student will be able to:

1. understand the meaning of research and concept of research design.
2. develop a research plan.
3. write a research report.
4. use of computer technology in research.
5. use latex for mathematical type setting.

Unit I: Research Methodology: An Introduction : Meaning of Research , Objectives of Research, Motivation in Research ,Types of Research , Research Approaches , Significance of Research , Research Methods versus Methodology, Research and Scientific Method , Importance of Knowing How Research is Done , Research Process , Criteria of Good Research , Problems Encountered by Researchers in India. **15 Lectures**

Unit II: Defining the Research Problem: What is a Research Problem, Selecting the Problem , Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration , Conclusion. Research Design, Meaning of Research Design, Need for Research Design , Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Conclusion, Developing a Research Plan. **15 Lectures**

Unit III: Meaning of Interpretation, Why Interpretation?, Technique of Interpretation: Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports. The Computer: Its Role in Research, The Computer and Computer Technology, The Computer System, Important Characteristics, The Binary Number System, Computer Applications, Computers and Researcher. **15 Lectures**

Unit IV: What is LATEX? Simple typesetting, Fonts, Type size , Tables, Basic Typesetting of Mathematics: Superscripts and subscripts, Roots, Mathematical symbols , Custom Commands, Single equations , Groups of equations , Numbered equations, Matrices, Typesetting Theorems. **15 Lectures**

Seminars, Tutorials, Problem solving session and group discussions on above four units

Recommended Book:

1. C. R. Kothari, Research Methodology – Methods and Techniques, (Second Revised Edition), New Age International Publications,
1. LATEX Tutorials A Primer, Indian TEX Users Group, Trivandrum, India, 2003 September.

References:

2. Higham Nicholas J., Handbook of writing for the mathematical sciences, SIAM, 1961.
3. Michael Alley, *The Craft of Scientific Writing (3rd Edition)*, Springer, New York, 1996
4. Philip Reubens (General editor), *Science and Technical Writing – A Manual of Style (2nd Edition)*, Routledge, New York, 2001

M. Sc. Mathematics (Distance Mode) (Part I) (Level-6.0) (Semester II)
(NEP-2020)
(Introduced from Academic Year 2023-24)

Title of Course: Algebra
Total Credits: 04
Course Outcomes: Upon successful completion of this course, the student will be able to:
1. study group theory and ring theory in some details.
2. introduce and discuss module structure over a ring.
3. apply Sylow theorems.
4. use homomorphism and isomorphism theorems.
5. check irreducibility of polynomials over Q using Eisenstein criteria.

Unit I: Group of permutations, Examples, Alternating Groups, Simple groups, simplicity of A_n ($n > 4$), Applications, Subnormal and Normal Series, Jordan-Holder Theorem, The Center and the Ascending Central Series, Isomorphism Theorems. **15 Lectures**

Unit II: The Zassenhaus (Butterfly) Lemma, Schreier Theorem, Group action on a set, fixed sets and isotropy subgroups, Orbits, Applications of G-Sets to Counting, Burnside theorem, p-groups, The Sylow Theorems.
15 Lectures

Unit III: Applications of Sylow theorems to p-Groups and the Class equation, Further Applications, Polynomial in an Indeterminate, Polynomial rings, The evaluation Homomorphisms, Factorization of Polynomials over Fields**,** The Division Algorithm in F[x], Irreducible Polynomials, Eisenstein criteria, Ideal Structure in F[x], Uniqueness of Factorization in F[x]. **15 Lectures**

Unit IV: Principal Ideal Domain (PID), Uniqueness of Factorization Domain(UFD), Gauss lemma, Introduction and Definition of Euclidean Domain, Arithmetic in Euclidean Domains. Definitions and Examples of Modules, Direct Sums, Free Modules, sub-modules, Quotient Modules, Homomorphism, Simple Modules. **15 Lectures**

Seminars, Tutorials, Problem solving session and group discussions on above four units

Recommended Book(s):

1. John B. Fraleigh , A first course in Abstract Algebra (Third Edition), Narosa publishing house, New Delhi.
2. C. Musili, Introduction to Rings and Modules (Second Revised Edition), Narosa Publishing house, New Delhi.

Reference Books:

1. Joseph A. Gallian, Contemporary Abstract Algebra (Fourth Edition), Narosa Publishing house, New Delhi.
2. Bhattacharya, Jain and Nagpal, Basic Abstract Algebra, 2nd edition, Narosa Publishing House, New Delhi.
3. I. N. Herstein, Topics in Algebra, Vikas Publishing House.
4. N. Jacobson, Basic Algebra, Hind Publishing Corporation, 1984.

M. Sc. Mathematics (Distance Mode) (Part I) (Level-6.0) (Semester II)
(NEP-2020)
(Introduced from Academic Year 2023-24)

Title of Course: Topology
Total Credits: 04
Course Outcomes: Upon successful completion of this course, the student will be able to:
1. built foundations for future study in analysis, in geometry, and in algebraic topology.
2. introduce the fundamental concepts in topological spaces.
3. acquire demonstrable knowledge of topological spaces, product spaces, and continuous functions on topological spaces.
4. identify compact and connected sets in topological spaces.
5. use Separation and countability axioms, Urysohn lemma, Urysohn metrization.

Unit I: Topological Spaces, Basis and Subbasis for a Topology, The Order Topology, The Product Topology on $X \times Y$, The Subspace Topology. **15 Lectures**

Unit II: Closed Sets , Closure and Interior of a Set, Limit Points, Hausdorff Spaces, Continuity of Functions, Homeomorphisms, The Product Topology, The Metric Topology. **15 Lectures**

Unit III: Connected Spaces, Connected Subspaces of the Real Line, Components and Local Connectedness, Compact Spaces, Compact Subspaces of the Real Line. **15 Lectures**

Unit IV: The Countability Axioms, The Separation Axioms, Normal Spaces, The Urysohn Lemma, The Urysohn Metrization Theorem (Only statement and its importance), The Tietze Extension Theorem (Only statement and its importance). **15 Lectures**

Seminars, Tutorials, Problem solving session and group discussions on above four units

Recommended Book:

1. J. R. Munkers, Topology, Second Edition, Pearson Education (Singapore), 2000.

Reference Books:

1. W. J. Pervin, Foundations of General Topology, Academic Press, New York, 1964.
2. J. L. Kelley, General Topology, Springer-Verlag, New York, 1955.
3. S. Willard, General Topology, Addison-Wesley Publishing Company, 1970.
4. K. D. Joshi, Introduction to General Topology, New Age International, 1983.
   G. F. Simmons, Introduction to Topology and Modern Analysis, McGraw Hill Book Company, New Delhi, 1963.

M. Sc. Mathematics (Distance Mode) (Part I) (Level-6.0) (Semester II)
(NEP-2020)
(Introduced from Academic Year 2023-24)

Title of Course: Advanced Calculus
Total Credits: 04
Course Outcomes: Upon successful completion of this course, the student will be able to:
(i) Analyze convergence of sequences and series, double sequences and double series
(ii) Analyze convergence of sequences and series of functions
(iii)check differentiability of functions of several variables
(iv) Apply inverse and implicit function theorems for functions of several variables

Unit I : Sequences and series of functions: Pointwise convergence of sequences of functions, Examples of sequences of real valued functions, Definition of uniform convergence, Uniform convergence and continuity, Cauchy condition for uniform convergence, Uniform convergence and Riemann integration, Uniform convergence and differentiation

15 Lectures

Unit II: Rearrangement of series, subseries, Double sequences, Double series, rearrangement of double series, sufficient condition for equality of iterated series, multiplication of series, Cesaro summability, sufficient conditions for uniform convergence of series, uniform convergence and double sequences, mean convergence, Taylor series generated by a function, Bernstein's theorem, binomial series.

15 Lectures

Unit III: Multivariable differential Calculus: The Directional derivatives, directional derivatives and continuity, total derivative, total derivatives expressed in terms of partial derivatives, The matrix of linear function, mean value theorem for differentiable functions, A sufficient condition for differentiability, sufficient condition for equality of mixed partial derivatives, Taylor's formula for functions from R^n to R^1

15 Lectures

Unit IV: Implicit functions: Functions of several variables, Linear transformations, Differentiation, Contraction principle, The inverse function theorem, The implicit function theorem and their applications.

15 Lectures

Seminars, Tutorials, Problem solving session and group discussions on above four units

Recommended books:

1. Mathematical Analysis, Apostal, Second Edition, Narosa Publishing House.1974

Reference books:

1.Principles of mathematical Analysis, Walter Rudin, third Edition, McGraw Hill book company
2. Calculus Vol. I , Vol II, Tom M. Apostol, Second EditionWiley India Pvt. Ltd.
3. W.Fleming, Functions of several Variables,2nd Edition ,Springer Verlag, 1977.

M. Sc. Mathematics (Distance Mode) (Part I) (Level-6.0) (Semester II)
(NEP-2020)
(Introduced from Academic Year 2023-24)

Title of Course: Numerical Analysis - II
Total Credits: 02

Course Outcomes: Upon successful completion of this course, the student will be able to:

1) apply the methods to solve linear and nonlinear equations.
2) find numerical integration and analyze error in computation.
3) solve differential equations using various numerical methods.
4) determine eigen values and eigen vectors of a square matrix.
5) construct LU decomposition of a square matrix.

Unit I: Interpolation, differentiation and integration: Lagrange and Newton interpolations, Truncation error bounds, Newtons divided difference interpolation, finite difference operators, numerical differentiation, methods based on interpolation, numerical integration, methods based on interpolation, error analysis, Newton-Cotes methods, Error estimates for trapezoidal and Simpson's rule.

15 Lectures

Unit II: Numerical solution of differential equations: Euler method, analysis of Euler method, Backward Euler method, mid-point method, order of a method, Taylor series method, Explicit Runge-Kutta methods of order two and four, convergence and stability of numerical methods, Truncation error, error analysis.

15 Lectures

Seminars, Tutorials, Problem solving session and group discussions on above four units

Recommended Books:

1. M. K. Jain, S. R. K. Iyengar, R. K. Jain, Numerical methods for scientific and Engineering Computation (Fifth Edition), New Age International Publishers 2007.

Reference Books:

1. S. S. Sastry, Introductory methods of Numerical Analysis (Fifth Edition), PHI learning Private Limited, New Delhi 2012.
2. D. Kincaid, W. Cheney, Numerical Analysis Mathematics of Scientific Computing (Third Edition), American Mathematical Society.
3. J.C. Butcher, Numerical methods for ordinary differential equations (Second Edition), John Wiley & Sons Ltd, 2008.
4. Kendall E. Atkinson, An Introduction to Numerical Analysis (Second Edition), John Wiley & Sons 1988.

M. Sc. Mathematics (Distance Mode) (Part I) (Level-6.0) (Semester II)
(NEP-2020)
(Introduced from Academic Year 2023-24)

Title of Course: Number Theory
Total Credits: 04

Course Outcome-: Upon successful completion of this course, the student will be able to:-

1. learn more advanced properties of primes and pseudo primes.
2. apply Mobius Inversion formula to number theoretic functions.
3. explore basic idea of cryptography.
4. understand concept of primitive roots and index of an integer relative to a given primitive root.
5. derive Quadratic reciprocity law and its apply to solve quadratic congruences.

Unit I: Review of divisibility: The division algorithm, G.C.D., Euclidean algorithm, Diophantine equation ax + by = c. Primes and their distribution : Fundamental theorem of Arithmetic, The Goldbach Conjecture. **15 Lectures**

Unit II : Congruences : Properties of Congruences, Linear congruences, Special divisibility tests. Fermat's theorem : Fermat's factorization method, Little theorem, Wilsons theorem. Number theoretic functions : The functions τ and σ. The Mobius Inversion formula, The greatest integer function. **15 Lectures**

Unit III: Euler's Generalization of Fermat's theorem: Euler's phi function, Euler's theorem, properties of phi function, An application to Cryptography. Primitive roots : The order of an integer modulo n. **15 Lectures**

Unit IV: Primitive roots for primes, composite numbers having primitive roots, The theory of Indices. The Quadratic reciprocity law: Eulerian criteria, the Legendre symbol and its properties, quadratic reciprocity, quadratic reciprocity with composite moduli .

15 Lectures

Seminars, Tutorials, Problem solving session and group discussions on above four units

Recommended Books :

1. D.M.Burton : Elementary Number Theory, Seventh Ed.MacGraw Hill Education(India)Edition 2012, Chennai.

Reference Books :

1. S.B.Malik :Baisc Number theory, Vikas publishing House.
2. George E.Andrews : Number Theory, Hindusthan Pub. Corp.(1972).
3. Niven, Zuckerman : An Introduction to Theory of Numbers. John Wiley & Sons.
4. S. G. Telang , Number Theory, Tata Mc.Graw-Hill Publishing Co., New Delhi.
5. M.B. Nathanson, Methods in Number Theory, Springer(2009).

M. Sc. Mathematics (Distance Mode) (Part I) (Level-6.0) (Semester II)
(NEP-2020)
(Introduced from Academic Year 2023-24)

Title of Course: Quantitative techniques in operations Research
Total Credits: 04

Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Decide policy for replacement.
2. Calculate economic lot size.
3. Derive Poisson distribution theorem and compute attributes of distribution model.
4. Identify optimal path by using CPM and PERT.

Unit I: Replacement Problems: Introduction, Failure mechanism of items, Replacement policy for items whose maintenance cost increases with time and money values is constant, Money value, Present worth factor and discount rate, Replacement policy for items whose maintenance cost increases with time and money values changes with constant rate, Individual replacement policy: Mortality theorem ,Group replacement policy. **15 lectures**

Unit – II : Inventory – Introduction, Cost involved in inventory problems, variables in inventory problem, symbols in inventory , concept of Economic Ordering Quantity(EOQ), The EOQ models without shortage: Model I (a) The economic lot size system with uniform demand. Model I (b) Economic lot size with different rates of demand in different cycles. Model I (c) Economic lot size with finite Rate of Replenishment. (EOQ production model),EOQ model with shortages: Model II(a) The EOQ with constant rate of demand, scheduling time constant, Model II (c) The production lot size model with shortages. Probabilistic inventory Models, Instantaneous demand, no set up cost model Model VI(a) Discrete case Model VI(b) continuous case ,Problems on above models. **15 lectures**

Unit – III : Queuing Theory - Queuing systems , Queuing Problems: transient and steady states,A list of symbols, traffic intensity, Probability distributions in Queuing systems: Distribution of arrivals 'The Poisson process', Properties of Poisson process of arrivals, Distribution of inter-arrival times(Exponential process).Distribution of Departures(Pure death model), Analogy of exponential service time with Poisson Arrivals Model I : (M/M/I) : (∞ /FCFS):Birth and Death model ,Solution of model, Examples on model I, Problems. **15 lectures**

Unit – IV: PERT / CPM : Applications of PERT /CPM techniques, Network diagram representation. Rules for constructing the Network diagram, Time estimates and critical path in network analysis, Examples on optimum duration and minimum duration cost, Problems **15 lectures**

Seminars, Tutorials, Problem solving session and group discussions on above four units

Recommended Books:

1. S.D.Sharma : Operations Research Kedarnath and co. 1999

Reference Books:

1. Hamdy Taha : Operations Research, Macmillan and Co.
2. J.K. Sharma : Operations Research, Macmillan India Ltd. 1999.
3. R.K.Gupta : Operations researcTime estimates h, Krishna Prakashan Mandir, 1999

9. Scheme of Teaching

1. Each theory lecture shall be of 60 minutes.
2. In a week for each theory course 4 lectures shall be conducted.

10. Examination Pattern

Theory:

- **For 4 credit course:**
  University examinations shall be of 80 marks and internal examination of 20 marks
- **For 2 credit course:**
  University examinations shall be of 40 marks and internal examination of 10 marks

On Job Training/Field Project:

Assessment criteria of OJT/FP shall be based on final report, presentation and oral examination.

1. Student has to submit final report based on the work carried out during OJT/FP.
2. Student has to make a presentation of the work carried out during OJT/FP in front of university appointed panel of one external and one internal examiner.
3. Student has to give midterm presentation of the work carried out during OJT/FP.
4. OJT/FP Evaluation:

Midterm Presentation	20 Marks
Report and Completion certificate of OJT/FP	50 Marks
Presentation and oral examinations	30 Marks
Total	100 Marks

Research Project:

- **For 4 credit course:**

Assessment criteria of research project shall be based on final report/ dissertation, presentation and oral examinations. University examinations shall be of 80 marks and internal examination of 20 marks.

1. Research project viva by university appointed external and internal examiners.
2. Internal evaluation will be carried out by internal guide.
3. Research Project Evaluation:

Internal evaluation	20 Marks
Final report/ dissertation	50 Marks
Presentation and oral examinations	30 Marks
Total	100 Marks

- **For 6 credit course:**

Assessment criteria of research project shall be based on final report/ dissertation, presentation

and oral examinations. University examinations shall be of 100 marks and internal examination of 50 marks.

1. Research project viva by university appointed external and internal examiners.
2. Internal evaluation will be carried out by internal guide.
3. Research Project Evaluation:

Internal evaluation	50 Marks
Final report/ dissertation	70 Marks
Presentation and oral examinations	30 Marks
Total	150 Marks

Research Methodology:
University examinations shall be of 80 marks and internal examination of 20 marks.

11. Nature of Question Paper and Scheme of Marking:

End Semester Assessment:

Theory:

(I) Nature of the Theory Question Papers for courses of 4 credits:

1. There shall be 7questions each carrying 16 marks.
2. Question No.1 is compulsory. It consists of objective type questions.
3. Students have to attempt any four questions from Question No.2 to Question No.7.
4. Question No. 2 to Question No.7 shall consist of short/descriptive-answer type sub-questions.
5. Duration of university theory examination of 80 marks shall be of 3 hours.

(II) Nature of the Theory Question Papers for courses of 2 credits:

1. There shall be 4 questions.
2. Question No.1 is compulsory of objective type questions carrying 8 marks.
3. Students have to attempt any two questions from Question No.2 to Question No.4. Each question carries 16 marks.
4. Duration of university theory examination of 40 marks shall be of 2 hours.

Internal Assessment:

(I) Nature of the Internal Question Papers for courses of 4 credits:

The internal examination shall be of 20 marks and may consist of objective, short, descriptive type questions.

(II) Nature of the Internal Question Papers for courses of 2 credits:

The internal examination shall be of 10 marks and may consist of objective, short, descriptive type questions.

12. Equivalence of courses

M. Sc. Part I (Semester I and II)

Old Course				Equivalent Course		
Sem No.	**Course Code**	**Title of Old Course**	**Credit**	**Course Code**	**Title of New Course**	**Credit**
I	CC-101	Advanced Calculus	4	MSU0325MML926H3	Advanced Calculus	4
I	CC-102	Linear Algebra	4	MSU0325MML926G1	Linear Algebra	4
I	CC-103	Complex Analysis	4	MSU0325MML926I2	Complex Analysis	4
I	CC-104	Classical Mechanics	4	MSU0325MML926I3	Classical Mechanics	4
I	CC-105	Ordinary Differential Equations	4	MSU0325MML926G3	Ordinary Differential Equations	4
I	CC-106	Number Theory	4	MSU0325MEL926H1	Number Theory	4
II	CC-201	Real Analysis	4	MSU0325MML926G2	Real Analysis	4
II	CC-202	Algebra	4	MSU0325MML926H1	Algebra	4
II	CC-203	Topology	4	MSU0325MML926H2	Topology	4
II	CC-204	Numerical Analysis	4	MSU0325MML926G4 and MSU0325MML926H4	Numerical Analysis I and Numerical Analysis II	4
II	CC-205	Partial Differential Equations	4	MSU0325MML926J3	Partial Differential Equations	4
II	CC-206	Operations Research	4	MSU0325MEL926G7	Linear Programming and its Applications	4